Megger®

S1-5010
Diagnostic Insulation Tester

User Guide

SAFETY WARNINGS

- **Safety Warnings** and **Testing Precautions** must be read and understood before the instrument is used. **They must be observed during use**
- The circuit under test **must** be switched off, de-energised and isolated **before** test connections are made.
- The test terminal panel and side recess panel **must** be kept in a dry, clean condition.
- Circuits **must** be discharged before disconnecting the test leads - Capacitive loads can be lethal. See '**Testing Precautions'**.
- Circuit connections **must not** be touched during a test.
- In certain circumstances, break-down of the circuit under test may cause the instrument to terminate the test in an uncontrolled manner, possibly causing a loss of display and warning indications while the circuit remains energised. In this event, it is important that the circuit is discharged and the instrument is turned off, **before** touching any connections.

• Replacement fuses **must** be of the correct type and rating.

• The instrument should **not** be used if any part of it is damaged.

• Refer to '**Testing Precautions**' for further explanations and precautions.

NOTE

THE INSTRUMENT MUST ONLY BE USED BY SUITABLY TRAINED AND COMPETENT PERSONS.

Symbols used on the instrument

Caution: Refer to accompanying notes.

Risk of electric shock.

Equipment complies with relevant EU Directives

Equipment protected throughout by Double Insulation (Class II).

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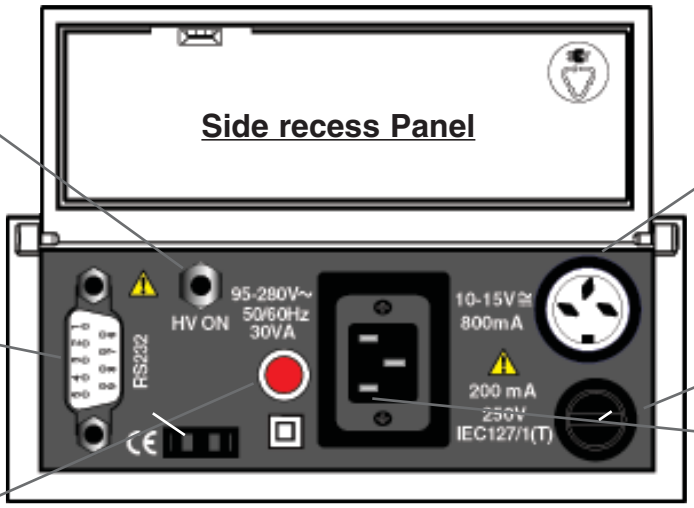
General Description

The S1-5010 is an advanced insulation tester for all types of electrical equipment offering measurement capability up to several T. The instrument performs automatic tests, enabling consistent operation without operator input, stores results and can be operated from a PC. Flexible power supply options and robust, portable construction allow the instrument to be used in a wide variety of applications. It is particularly suitable for analyzing the insulation of large machines, HV generators and cables. When turned On, voltage in excess of 50 volts across the + and - terminals will be indicated on the display, together with the flashing HV symbols.

Switchable filtering allows stable readings to made when in the presence of high levels of 50 Hz or 60 Hz interference.

Polarization Index and **Dielectric Discharge** tests are performed automatically, and test duration and voltages can be adjusted according to user preference for these tests. A **Step Voltage** test can also be performed automatically, with a voltage of 2500 V or 5000 V and a fixed test duration of 5 minutes. It is also possible to restrict operation to user defined voltages, to disable the graph plotting or to disable certain types of tests. This is all done using the '**Setup**' screen. The settings can be security code protected. It is also possible to set a general security code to prevent unauthorized use of the instrument.

The S1-5010 can be powered from the main supply, or by the its own internal rechargeable battery which provides for at least 8 hours of continuous testing. The battery symbol ,in the bottom left of the display indicates battery capacity. Connecting power to the supply connector, or to the 12 volt connector in the side recess panel will automatically charge the battery whether the instrument is switched '**On**' or '**Off**'. A high level of internal isolation allows the S1-5010 to be used while the battery is being recharged. An internal battery management system switches the instrument off after ten minutes of inactivity. Test results and settings will not be lost when the instrument is switched off.



HV 'On' indicator connection

5 V logic signa output.

(To connect an external HV indicator)

RS232 connection

Download '**Real time**' or '**Batch**' results to PC. Remote operation.

Battery Charge Indicator

12 V d.c. connection

Plug in supply of 10 - 15 V to charge the battery

Fuse

200 mA - 250 V

Mains connection

Plug in supply of 95 - 265 V a.c. to charge the battery.

Test results are stored internally but the RS232 connection allows an external computer to receive results in real time or to receive results previously stored.

Safe testing is achieved with a double insulated plastic case, double insulated test lead connectors, a one second delayed start test button, high voltage warning symbols ϟϟϟϟϟ , flash on the display, and the test terminal HV warning light flashes. A socket in the side recess panel provides a 5 volt logic signal to drive an external warning light. Capacitive loads are automatically discharged at the end of a test.

Beneath the display, four tactile keys normally control:-

- Electrical 'noise' Filter
- Contrast
- Back-light.

Features and Controls

Guard Terminal

Negative Terminal

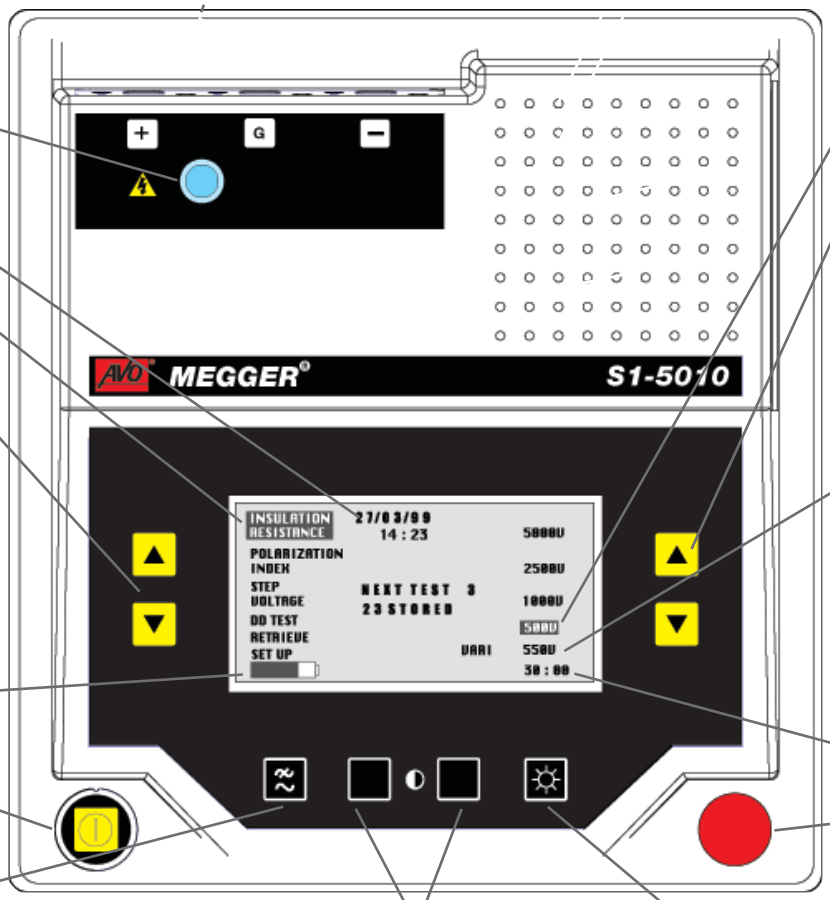
Positive Terminal

To insert and lock in shrouded test plugs

Push in

To release shrouded test plugs

turn a quarter turn and pull out



HV Warning

Flashes when a test is in progress or a hazardous voltage is present.

Date and time

Mode setting

Left Hand Cursor keys

Press to:-

i) Select and highlight the required mode.

ii) Select test **Results / & Bargraph / Graph** in Enhanced mode.
(when test has run ≥ 1 minute)

Voltage setting

Right Hand Cursor keys

Press to select and highlight the required voltage before commencing test.

VARI position

Gives the option to:-

i) Select a non standard voltage between 25 V and 5000 V before commencing test.

ii) Continuously vary the voltage in 25 V steps during a test.

Battery Capacity Indicator

Power On / Off Switch

Press to turn On / Off.

Test duration

Test Button

Filter key

Press to:-

i) Sequentially select filter times. (See '**Using the Filter**')

ii) Initiate the '**On screen**' display above the key.

Contrast keys

Press to:-

i) Adjust the screen contrast.

ii) Initiate the '**On screen**' display above the key

Backlight key

Press to:-

i) Switch backlight On or Off.

ii) Initiate the '**On screen**' display above the key.

Setting Up Procedures

The S1-5010 can be powered by:

- Internal rechargeable battery which provides at least 8 hours of testing.
- Mains input of 95 volts to 280 volts 50/60 Hz.
- 12 - 15 Volts d.c or a.c.

General

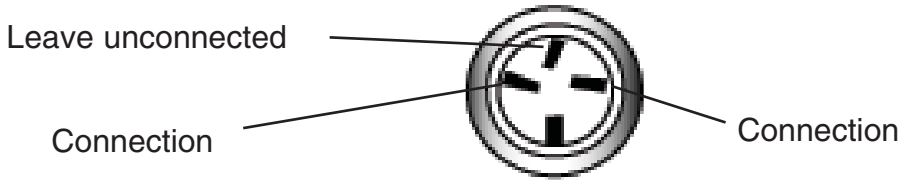
The S1-5010 is fitted with a 12 volt, 7 Amp-hour sealed lead-acid battery. The maintenance free battery will last for at least 5 years if kept charged and not subjected to prolonged high temperatures. (Occasional exposure to +50° C will do little harm but a continuous temperature >40° may cause irreparable damage). It is advisable to fully charge the battery before the instrument is put into service for the first time. Charging is carried out by external a.c. mains supply, or by 12 V d.c. or a.c. supply. To fully recharge the battery after 8 hours of use takes about 16 hours. The battery capacity display symbol indicates the state of charge.

Mains supply re-charging

The application of a mains supply of 95 - 265 V a.c., 50 - 60 Hz powers the instrument, and charges the battery. The S1-5010 will operate on a supply as low as 90 volts, but this will not fully charge the battery. Charging is automatic as soon as the mains supply is connected to the IEC 320 connector in the side recess panel. Confirm that the red indicator lamp is illuminated.

12 V supply re-charging

The application of an external 12 - 15 volt d.c or a.c. supply powers the instrument and charges the battery at the same rate of charge as the mains input. It is possible to connect both mains and a 12 volt input simultaneously, but this will not charge the battery any faster. The socket accepts 12 -15 volt d.c. (any polarity connection) or 12 - 15 volt a.c. A charging lead fitted with an automotive cigar lighter plug for charging the battery from a vehicle is available (See '**Accessories**'). Charging is automatic as soon as the 12 V supply is connected to the 12 V DIN socket. Confirm that the red indicator lamp is illuminated.



12 V DIN socket

Caution:- Applying more than 15 V to this socket may overcharge the battery.

Battery Charging Notes

- Do not leave battery in a totally discharged state. Frequent charging to keep the battery 'topped up' will maximise battery life.
- When charging the battery indoors, the area should be well ventilated.
- The battery should only be charged at temperatures in the range 0 °C to 40 °C.
- No harm will occur to the battery is kept on charge indefinitely.
- If the instrument is idle for long periods, recharge the battery for at least 24 hours every 6 months (more frequently if the storage temperature is >40 °C).

Setting Up Procedures

Note: † If pre-set, the '**SETUP**' security code input screen will be displayed. Enter the 3 digit security code using the '**+**' ◘, '**-**' ■ and '**NEXT**' ■ keys. Press the '**OK**' ◘ key to display the '**SETUP**' screen.

Setup Screens

Any changes made to the '**Setup**' screens will be retained. Memory contents will only be lost in the unlikely event of a power loss combining a failure of the main and the backup battery. When power is restored, **Setup** conditions will revert to the default settings i.e. All tests enabled , all voltages enabled, First **PI** value **T1** = 1minute, Second value **T2** = 10 minutes, Stop time (**T3**) = 10 minutes, and enhanced test mode.

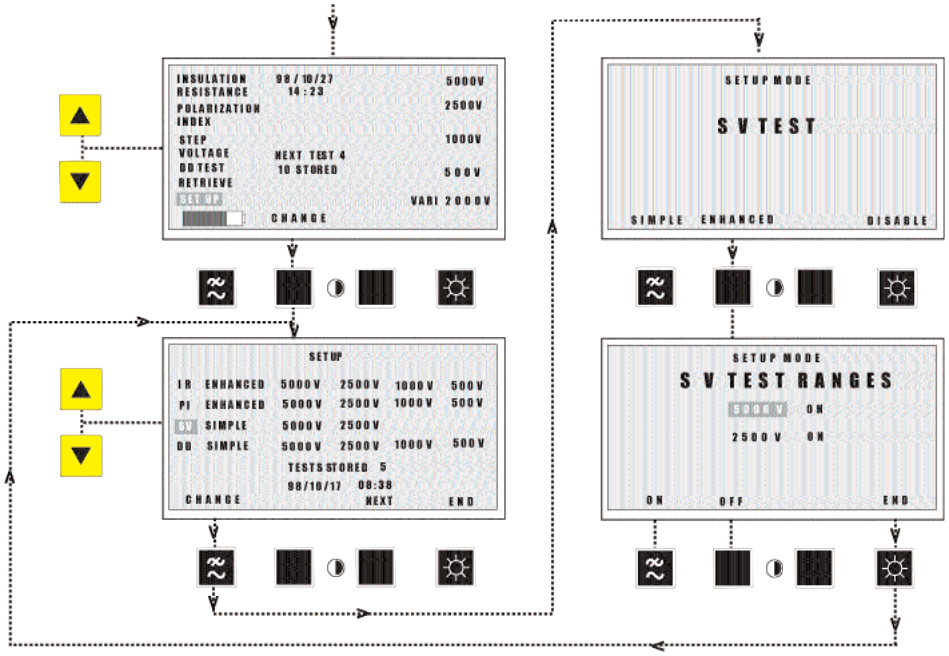
Setup Language §

1. From the first '**Menu**' screen, use the left hand st cursor keys to select and highlight '**SETUP**'.
2. Press the '**CHANGE**' ■ key. **†§** The '**LANGUAGE SELECTION**' screen is displayed.
3. Use the left hand cursor keys to select and highlight the required language.
4. Press the '**YES**' key. The '**SETUP**' screen is displayed.

Setup IR, SV and DD Tests

Simple or Enhanced mode can be selected for each type of test (except **DD** test). '**SIMPLE**' mode provides basic test results during, and on completion of a test. '**ENHANCED**' mode provides basic test results and a graph plot and a Bargraph as the test progresses. Individual voltage ranges for each type of test can be switched Off or On as required.

1. From the '**Menu**' screen, use the left hand cursor keys to select and highlight '**SETUP**'.
2. Press the '**CHANGE**' ■ key. **†§** The '**SETUP**' screen is displayed.
3. Use the left hand cursor keys to select and highlight the required test.
4. Press the '**CHANGE**' ◘ key. The '**SETUP MODE**' option screen for the selected test is displayed.
5. Press the '**SIMPLE**' ◘ or the '**ENHANCED**' ■ key as required. The '**TEST RANGES**' screen is displayed. **Note:-** selecting the '**DISABLE**' ◘ key will disable and remove the test from the '**Menu**' screen. See '**Disable a Test**'.
6. Use the left hand cursor keys to individually select and highlight any voltage ranges to be switched Off or On. Press the '**On**' ◘ or '**OFF**' ■ key, as appropriate.
7. On competion, press the '**END**' ◘ key to return to the '**SETUP**' screen.
8. Press the '**END**' ◘ key to return to the '**Menu**' screen.



Example showing the setup of an enhanced SV Test

Setup PI Test

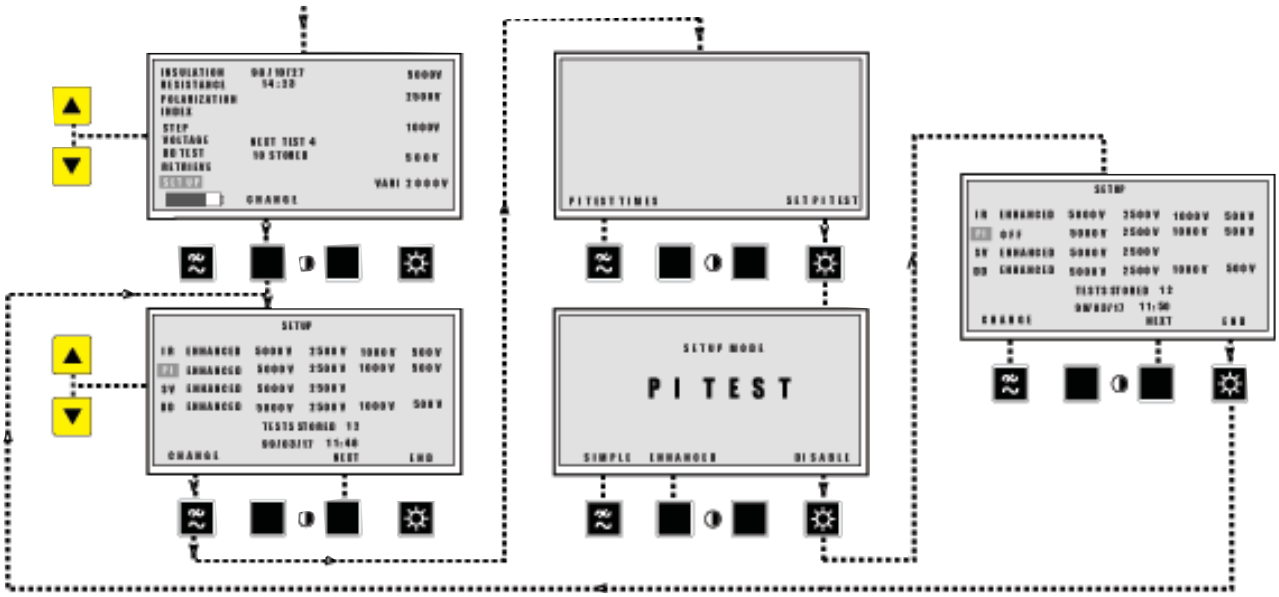
1. From the '**Menu**' screen, use the left hand cursor keys to select and highlight '**SETUP**'.
2. Press the '**CHANGE**' ■ key. †§ The '**SETUP'** screen is displayed.
3. Use the left hand cursor keys to select and highlight '**PI**'. Press the '**CHANGE**' ◘ key. The '**PI TEST SETUP**' screen is displayed.
4. Press the '**PI TEST TIMES**' ◘ key. The '**PI TEST TIMES**' screen is displayed.
5. Press the '**NEXT**' ◘ key to highlight and select the **First Value**, the **Second Value** or the **Stop Time** as required.
6. Using the '**+**' ■ et '**-**' ■ keys, adjust the timing as required.
7. Press the '**OK**' ◘ key to return to the '**PI TEST SETUP**' screen.
8. Use the left hand cursor keys to select and highlight '**PI**'. Press the '**CHANGE**' ◘key. The '**PI TEST SETUP**' screen is displayed.
9. Press the '**SET PI TEST**' ◘ key. The '**PI TEST SETUP MODE**' screen is displayed.
10. Press the '**SIMPLE**' ◘ or the '**ENHANCED**' ■ key as required '**TEST RANGES**' screen is displayed. **Note:-** selecting the '**DISABLE**' ◘ key will disable and remove the **IP** test from the '**Menu**' screen. See '**Disable the Test**'.
11. Use the left hand cursor keys to individually select and highlight any voltage ranges to be switched Off or On. Press the '**ON**' ◘ or '**OFF**' ■ key, as appropriate.
12. On completion, press the '**END**' ◘ key to return to the '**SETUP**' screen.
13. Press the '**END**' ◘ key to return to the '**Menu**' screen.

Disable a Test mode

When a test mode is disabled, it is removed fromthe '**Menu**' screen.

1. From the '**Menu**' screen, use the left hand cursor keys to select and highlight '**SETUP**'.
2. Press the '**CHANGE**' ■ key. †§ The '**SETUP**' screen is displayed.
3. Use the left hand cursor keys to select the test to be disabled.
4. Press the '**CHANGE**' ◘ key. The '**SETUP MODE**' screen is displayed.
5. Press the '**DISABLE**' ◘ key. The '**SETUP'** screen is displayed.
6. Press the '**END**' ◘ key to return to the '**Menu**' screen.

Alternatively, a test can be disabled by individually setting each test voltage to '**OFF**'.

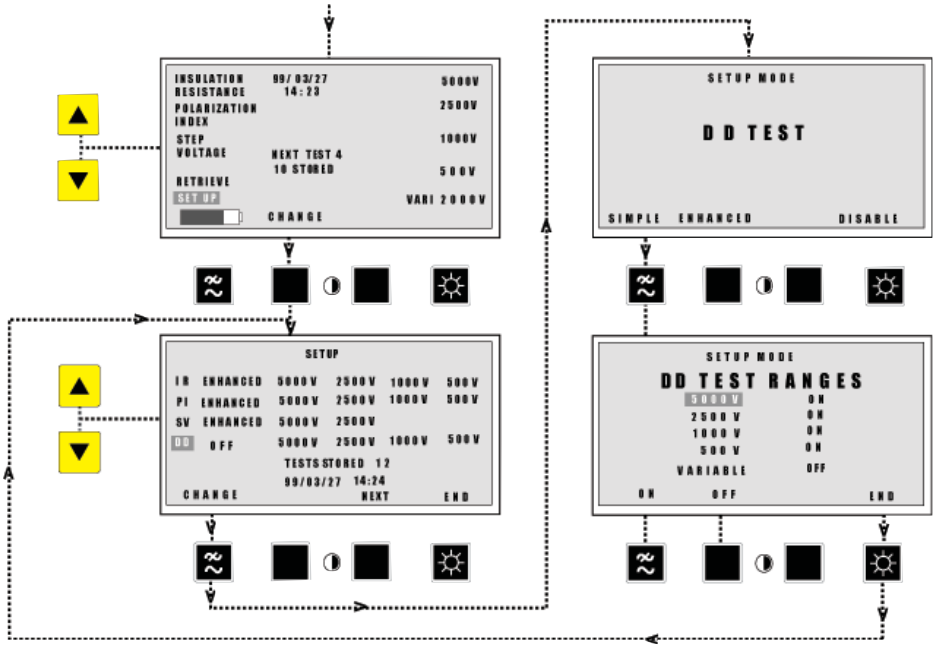


Example showing the disabling of a PI Test

Enable a Test mode

1. From the '**Menu**' screen, use the left hand cursor keys to select and highlight '**SETUP**'.
2. Press the '**CHANGE**' ■ key. †§ The '**SETUP**' screen is displayed.
3. Use the left hand cursor keys to select the test (identified as **OFF**) to be enabled.
4. Press the '**CHANGE**' ◘ key. The '**SETUP MODE**' screen is displayed.
5. Press the '**SIMPLE**' ◘, or the '**ENHANCED**' ■ key, as required. The '**TEST RANGES**' screen is displayed.
6. Use the left hand cursor keys to individually select and highlight any voltage ranges to be switched Off or On. Press the '**ON**' ◘ or '**OFF**' ■ key, as appropriate.
7. On completion, press the '**END**' ◘ key to return tothe '**SETUP**' screen.
8. Press the '**END**' ◘ key to return back to the '**Menu**' screen.

Alternatively, a test can be enabled by individually setting at least one test voltage to '**ON**'.



Example showing the enabling of a DD Test

Delete Stored Test results

1. From the '**Menu**' screen, use the left hand cursor keys to select and highlight '**SETUP**'.
2. Press the '**CHANGE**' ■ key. †§ The '**SETUP**' screen is displayed.
3. Use the left hand cursor keys to select and highlight '**TESTS STORED**'. Press the '**CHANGE**' ◘ key. The '**DELETE ALL TESTS - CONFIRM**' screen is displayed.
4. Accept or reject the deletion by pressing the '**YES**' ■ or the '**NO**' ■ key. The '**SETUP MODE**' screen is displayed.
5. On completion press '**END**' ◘ key to return back to the '**Menu**' screen.

Set / Reset Date and Time

1. From the '**Menu**' screen, use the left hand cursor keys to select and highlight '**SETUP**'.
2. Press the '**CHANGE**' ■ key. †§ The '**SETUP**' screen is displayed.
3. Use the left hand cursor keys to select the current Date and Tiime.
4. Press the '**CHANGE**' ◘ key. †§ The '**SETUP MODE**'. '**SET CLOCK**' screen is displayed.
5. Press the '**NEXT**' ◘ key to highlight and select the Time / Date component to be adjusted.
6. Using the '**+**' ■ and '**-**' ■ keys, adjust the time / Date as required.

7. Press the '**END**' ▣ key to return to the '**SETUP'** screen.
8. Press the '**END**' key to return back to the '**Menu**' screen.

Note:- Date format can be also be changed as required. See '**Set / Reset Date Format'**.

Set / Reset Printer Baud Rate

This is the communication rate used when retrieving results to a serial printer.

1. From the '**Menu**', screen, use the left hand cursor keys to select and highlight '**SETUP'**.
2. Press the '**CHANGE**' ■ key. **†§** The '**SETUP'** screen is displayed.
3. Press the '**NEXT**' ▣ key. Use the left hand cursor keys to select and highlight '**PRINTER BAUD**'.
4. Press the '**CHANGE'** ▣ key. **†§** The '**PRINTER BAUD**' screen is displayed.
5. Use the '**NEXT**' ■ key to select and highlight the **Baud Rate** as required.
6. Press the '**END**' ▣ key.
7. Press the '**END**' ▣ key to return back to the '**Menu**' screen.

Set / Reset PC Baud Rate

This is the communication speed to your PC when retrieving results to a PC file and does not affect the speed when using the S1-5010 with the remote control software. The default Baud rate is **9600**.

1. From the '**Menu**' screen, use the left hand cursor keys to select and highlight '**SETUP'**.
2. Press the '**CHANGE**' ■ key. **†§** The '**SETUP'** screen is displayed.
3. Press the '**NEXT**' ■ key. Use the left hand cursor keys to select and highlight '**PC BAUD'.**
4. Press the '**CHANGE**' ▣ key. The '**PC BAUD'** screen is displayed.
5. Use the '**NEXT**' ■ key to select and highlight the **Baud Rate** as required.
6. Press the '**END**' ▣ key.
7. Press the '**END**' ▣ key to return back to the '**Menu**' screen.

Security Codes

There are two security code systems to inhibit access by unauthorized persons. The user definable 3 digit '**Power On**' code controls access entry into the instrument. The user definable 3 digit '**Setup**' code controls access to the **Setup** displays.

Set / Reset 'Power On' Code

to set or re-set the 3 digit 'Power On' code to control access enty into the instrument the '**POWER ON SECURITY CODE'** is switched to On in the '**Setup**' mode. When the instrument is switched **Off** and **On** again, the new code is entered, to operate the instrument. This '**Power On**' code must then be entered by anyone wishing to use the instrument.

1. From the '**Menu**', screen, use the left hand cursor keys to select and highlight '**SETUP**'.
2. Press the '**CHANGE**' ■ key. **†§** The '**SETUP**' screen is displayed.
3. Press the '**NEXT**' ■ key. The '**SETUP MODE**' screen is displayed.
4. Use the left hand cursor keys to select '**POWER ON SECURITY CODE**'. Press the '**CHANGE**' ▣ key to set the code to '**ON'** (or '**OFF'** as required). If an existing code is to be changed, set the code to **OFF**; exit the screen; return back to the screen and then set the code back to '**ON'**.
5. Press the '**END'** ▣ key to exit back to the '**Menu**' screen.
6. Switch the instrument Off, pause, and then switch back On again. The '**ENTER THE SECURITY CODE**' input screen is displayed.
7. Enter (and remember) the new 3 digit security code using the '**+**' ▣, '**-**' ■ and '**NEXT**' ■ keys.

On completion, press the '**OK**' ▣ key. The instrument powers up and the '**Menu**' screen is displayed.

Set / Reset 'Setup' Code

To set or re-set the 3 digit '**Setup**' code, the code is switched from **OFF** to **ON**. The screen is then exited and on re-entry, the required user definable 3 digit code is entered. This '**Setup**' code must then be entered by anyone wishing to access the **Setup** screens.

1. From the '**Menu**' screen, use the left hand cursor keys to select and highlight **'SETUP**'.
2. Press the '**CHANGE**' ■ key. **†§** The '**SETUP**' screen is displayed.
3. Press the '**NEXT**' ■ key. The '**SETUP MODE**' screen is displayed.
4. Use the left hand cursor keys to select and highlight '**SETUP SECURITY CODE**'.
5. Press the '**CHANGE**' ■ key to set the code to '**ON'** (or '**OFF'**). If an exisiting code is to be changed, set the code to '**OFF'**; exit the screen; return back to the screen and then set the code back to '**ON'**.
6. Press the '**END**' ■ key to exit back to the '**Menu**' screen.
7. Highlight '**SETUP**', and press the '**CHANGE**' ■ key. The '**ENTER THE SECURITY CODE**' screen is displayed.
8. Enter (and remember) the new 3 digit security code using the '**+**' ■, '**-**' ■ and '**NEXT**' ■ keys.
9. Press the '**END**' ■ key to return back to the '**Menu'** screen.

Note:- Persons with access to the **Setup mode** will also be able to access (and control) the '**Power On**' code.

Set / Reset Date Format

Date format can be selected as **DD / MM / YY - YY / MM / DD - MM / DD / YY**. Note that changes to the Date format will only be shown in subsequent test data.

1. From the '**Menu**' screen, use the left hand cursor keys to select and highlight '**SETUP**'.
2. Press the '**CHANGE**' ■ key. †§ The '**SETUP**' screen is displayed.
3. Press the **'NEX**T' ■ key. The '**SETUP MODE**' screen is displayed.
4. Use the left hand cursor keys to select and highlight '**DATE FORMAT**'.
5. Press the '**CHANGE**' ■ key to select the appropriate sequence for Day (**DD**) Month (**MM**) and Year (**YY**).
6. Press the '**END**' ■ key to return back to the '**Menu**' screen.

Set / Reset Current limit

1. From the '**Menu**' screen, use the left hand cursor keys to select and highlight '**SETUP**'.
2. Press the '**CHANGE**' ■ key. †§ The '**SETUP**' screen is displayed.
3. Press the '**NEXT**' ■ key. The '**SETUP MODE**' screen is displayed.
4. Use the left hand cursor keys to select and highlight '**CURRENT LIMIT**'.
5. Press the '**CHANGE**' ■ key to select **2 mA** or **5 mA**.
6. Press the '**END**' ■ key to return back to the '**Menu**' screen.

Set / Reset Data Output Rate - for 'Real time' output

1. From the 'Menu' screen, use the left hand cursor keys to select and highlight '**SETUP**'.
2. Press the '**CHANGE**' ■ key. †§ The '**SETUP**' screen is displayed.
3. Press the '**NEXT**' ■ key.
4. Press the '**NEXT**' ■ key again. '**DATA OUTPUT EVERY...**' is displayed.
5. Press the '**Change**' ■ key. The '**+**' and '**-**' controls are displayed.
6. Using the '**+**' and '**-**' ■ keys, adjust the Data Rate as required. Maximum = 1 second, Minimum = 60 seconds
7. Press the '**OK**' ■ key.
8. Press the '**END**' ■ key to return back to the '**Menu**' screen.

Set / Reset Locking Test button

The red Test button defaults to locking, when pushed for more than 1 second. The button can be set to '**Locked**' or '**Unlocked**'.

1. From the '**Menu**' screen, use the left hand cursor keys to select and highlight '**SETUP**'.
2. Press the '**CHANGE**' ■ key. †§ The '**SETUP**' screen is displayed.
3. Press the '**NEXT**'■ key.
4. Press the '**NEXT**' ■ key again.
5. Use the left hand cursor keys to select and highlight '**TEST BUTTON**'.
6. Press the '**Change**' ■ key to select '**LOCKING**', or '**NOT LOCKING**', as required.

Note:- If '**NOT LOCKING**' is selected,'**Fault Conditioning**' - (**BURN**) mode is not available.

7. Press the '**OK**' ■ key.
8. Press the '**END**' ■ key to return back to the '**Menu**' screen.

Operation

⚠ Testing Precautions

The circuit under test must be completely de-energized and isolated before test connections are made

- The S1-5010 can generate up to **5 mA at 5000 V**. Circuit connections **must not** be touched when testing.
- When turned On, voltage in excess of 5 volts across the **+** and **-** terminals will be indicated on the display.
- The voltage indicator and automatic discharge features of the S1-5010 should be regarded as additional safety features and not a substitute for normal safe working practice.
- When carrying out prolonged unattended tests, care should be taken ensure that harm or damage cannot be caused.
- When using the'**BURN**' feature, care **must** be taken that no harm or damage can be caused.
- The test terminal area and side recess panel recess **must** be kept in a dry, clean condition.
- If any part of the instrument is damaged, it should not be used, but returned to the manufacturer or an approved repair company.
- Fuse replacement must be of the correct type and rating. See "**Specification**'.
- Should the plug on the power cord not be the type for your socket outlets (receptacles), do not use an adaptor. Use a suitable alternative power cord. Wires in power cords are coloured as follows: -

	U.K / International	U.S.A.
Earth (Ground	Yellow/Green	Green
Neutral	Blue	White
Phase (Line)	Brown	Black

If using a fused plug, a 3 Amp fuse to BS1362 should be fitted.

⚠ Working with Capacitive Loads

Charged Circuit Discharge

Capacitive circuits charged to several kV can be lethal.

Circuits must be discharged before handling and connecting the test leads, and similarly before disconnecting the test leads.

At the end of a test, any external capacitance is discharged automatically and the warning devices will continue to indicate until the terminals are in a safe condition. While the instrument design incorporates maximum safety, safe working practice should assume that the instrument discharge circuit and warning devices could fail, and **a shorting link should be connected across capacitive loads before handling them**

* Automatic discharge must not be relied upon as an alternative to normal safe working practice.
* Care must be taken to prevent capacitive circuits becoming disconnected during a test, leaving the circuit in a charged state.

Dielectric Absorption

Some capacitive items exhibit an effect called Dielectric Absorption. The dielectric can absorb charge during the test. After the item is discharged, the absorbed charge is released back onto the capacitive 'plates' effectively raising the voltage of the item, possibly to dangerous levels. Safe working practice dictates that **tested items should be firmly shorted out with a shorting link, after discharge, until required for use**

Performing Tests - General

- Ensure that all test leads are clean and in good condition, and firmly connect them to the instrument and to the isolated circuit under test.
- Switch the instrument On by pressing the yellow '**On / Off**' switch once. The calibration check runs to check the operation of the measurement system and correct any small calibration errors which may occur during the life of the instrument.
- The '**Menu' screen** is displayed on completion of the calibration check. If necessary, adjust the contrast setting using the ■.key.
- The ◘ key allows the back light to be switched On or Off. (Switching the back light off, will conserve battery power by 10%).
- Select the required Test mode using the left hand cursor keys.
- Test time shown in the bottom right hand corner of the display indicates maximum test duration before it is stopped automatically. (Maximum test duration is 90 minutes). Accept the default test time or use the right hand cursor keys to select and highlight the time indicator. Press the ■ '**CHANGE**' key, followed by the '**+** / **-**' ■ keys to set the required time.
- The required **Test Voltage** is selected with the right hand cursor keys. For specific types of test, pre-determined default voltages are set. For instance, the **Step Voltage** test only offers test voltage options of 2500 or 5000 volts. The '**VARI**' position gives the option to select a non-standard voltage between 25 and 5000 V d.c., or to continuously vary the voltage in 25 V steps during a test by using the right hand cursor keys.
- **Battery condition** indication is given in the bottom left hand corner of the display. If the battery becomes completely exhausted the instrument will refuse to operate. Recharge the battery as soon as possible. If the battery is not recharged it could degrade to a state where it will not recharge.

Note:- Test results and settings are protected by a backup battery so these will not be lost.

- **To start a Test**, press the red button for at least one second. Two bleeps are sounded and the ⚠, flashing test terminal indicator light, and symbols warn that a test is in progress.
- If Enhanced tests have been selected, after one minute, three types of result screen can be selected (**Results** / **Bargraph** / **Graph**) using the left hand cursor keys either during, or after a test.
- **To stop a test at any time**, press the red test button. If the red test button is not pressed, the test will terminate at the end of the set test duration
- Allow the item to discharge.
- A test will automatically terminate if:-
  - The set test duration is completed.
  - Excessive electrical noise occurs.
  - The circuit insulation under test suffers a complete breakdown.
  - The battery becomes exhausted.
  - The 200 mA Guard fuse ruptures (when the Guard terminal is in use).

- An internal fault occurs.
- When the test is terminated the item under test will be automatically discharged.

- **To return to the menu display** and start another test, press the '**Menu**' ◘ key.
- To switch the instrument Off, press the **On / Off** button once. Auto switch-off operates after 10 minutes inactivity.
- On completion of a test, the item under test is automatically discharged. The high voltage warnings continue to operate until the terminal voltage falls to less than 50 volts. If the test has run for more than one minute, three types of result display can be selected (**Results / Bargraph** / **Graph**) using the left hand cursor keys.

Using the Filter

If stable readings are being obtained it is not necessary to use the filter. The multi-pole electrical interference filter system enables measurements to stabilise in a few seconds while rejecting 50Hz and 60Hz interference currents, up to 4 mA. Under adverse conditions it may be necessary to switch in additional software filtering. A steady reading will then be obtained at the expense of a longer settling time.

Filter settings available:

	No Filter.	Fastest settling time. Rejects a.c. interference up to 1 mA.
Default-	**FILT 3:**	Hardware filter. Approximately 3 second settling time. 4 mA a.c. rejection.
	FILT 10:	Adds software filter giving moving average over 10 seconds.
	FILT 30:	As above, for 30 seconds.
	FILT 100:	As above, for 100 seconds.

At the start of a test, the default setting **FILT 3** is set. This provides very good interference rejection, allowing measurements to be made quickly. Pressing the filter ◘ key will sequentially advance filter settings. To optimise the settling time, toggle the filter key several times to turn the filter Off. Note that if the filter is turned On again (either manually or automatically) it may cause a transient change in the reading which can last up to several seconds.

Tip: If a long time constant filter is in use, toggle the filter ◘ key to re-start the filter and obtain the required reading faster.

Note:- When testing at less than 500 volts, the tolerance to external interference is reduced. This is because of voltage regulation problems caused by a.c. current flowing into the positive terminal impedance of about 80 kΩ. Such a condition will be evident by the fact that the terminal voltage will change from its set value.

Note:- Selecting a new filter time discards all previous readings and begins building up a new average. The displayed value will move to the most recently acquired result. e.g. If **FILT 3** is in operation and the filter ◘ key is pressed once (to select the **FILT 30**) the most recent unfiltered result is displayed. This will be followed by the average of two results, three results, four results etc. until it showing the average of the last 30 results. Note that averaging is performed on measured current (not calculated resistance). This is the best way to reject incoming a.c. interference but it can produce some unusual settling characteristics when observing resistance measurements.

Fault Conditioning (Burn)

BURN disables the normal 'breakdown' detection and enables the Insulation test voltage to continue even after breakdown at any weak point of the circuit insulation. This will enable the location of the failure to be seen or heard.

Note:- The Test Button must be be set to '**LOCKED**' position to use the **BURN** mode

> ⚠ **Care must be taken that no unintentional harm or damage can be caused**

1. **Setup** the Test Button to the '**LOCKED**' position. See '**Set / Reset Locking Test button**'.
2. From the '**Menu**' screen, select' **INSULATION RESISTANCE'** using the left hand cursor keys.
3. Use the right hand cursor keys to select and highlight the time indicator. Press the '**CHANGE**' ■ key, followed by the '**+** / **-**' ■ keys to set the required time.
4. Set the required **Test Voltage** with the right hand cursor keys.
5. Press, and hold the red button for at **least five seconds**. Two bleeps are sounded. To warn that a test is in progress, **BURN** is displayed, alternating with ϟϟϟϟϟ , symbols. The test terminal indicator light flashes.
6. Test progression is shown by a **Bargraph**. Using the left hand cursor keys a **Results** or **Graph** result screen can be selected either during, or after a test.

⚠ Break-down of the circuit and the related noise interference may cause the instrument terminate the operation, possibly causing a loss of display **while the circuit remains energised**. In this event, it is important that the circuit is discharged **before** touching any connections. If necessary, switch the instrument off, and then on again to reset the display.

7. **To stop the test at any time**, press the red test button. '**DISCHARGING**' is displayed, until the circuit is in a safe condition.
8. **To return to the menu display** press the '**Menu**' ◘ key.
9. If required, **Setup** the test button to the '**NOT LOCKED**' position.

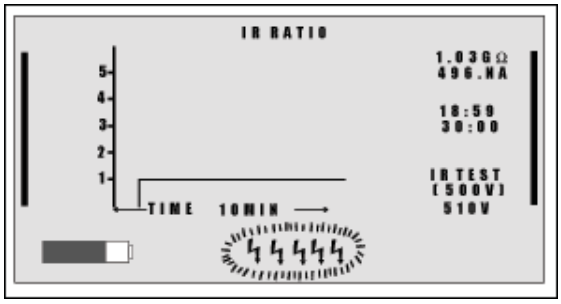
Remote operation

A software package S1-S1 is available for controlling the S1-5010 directly from a PC. You may also automatically define certain test sequences. See '**Accessories**'.

Test Mode Summary

Insulation Resistance Testing

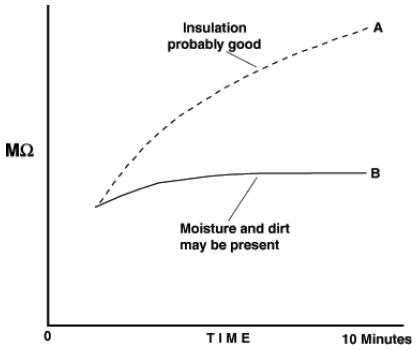
This test mode measures insulation resistance continuously at the selected voltage. The test is applied for a short but specific duration, immediately after which a reading is taken. Test duration is typically 30 or 60 seconds and the S1-5010 will allow you to set this duration, and the test will finish automatically. The reading will not necessarily be the maximum value but if the same duration is used each test, then the same point on the curve of increasing apparent resistance is being compared. On installation these readings will be compared to the required minimum specification. Further readings taken for maintenance purposes must be monitored for any trend that they show. The readings are subject to variation from temperature and humidity and these factors may require the insulation reading to be corrected. Information on temperature correction is given in the MEGGER publication '**A Stitch in Time**'. Alternatively, a Polarization Index (**PI**) test may be used.



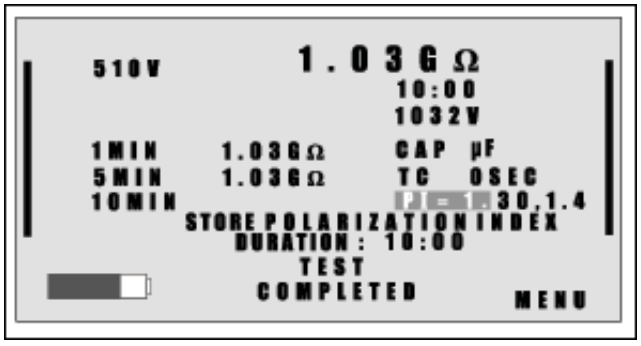
Example of IR Graphic display

Polarization Index (PI) Test

Time resistance tests are successive insulation readings at specified times, taking the ratio of dielectric absorption into account, and are independent of temperature. Good insulation generally shows an increase in resistance over a 10 minute period. With contaminated insulation, absorption effects are masked by high leakage currents and the readings are therefore fairly flat.



The **PI** test is a particular example of the time resistance method, and takes the ratio of the insulation values at 1 minute (designated **T1**) and at 10 minutes (designated **T2**) - this is the **Polarization Index**. The **PI** test also has the advantage of not requiring temperature correction.



Example of PI display

The value of **PI** can often help in the situation where past test record frequency are limited, by giving a rough guide to condition of insulator. The figures should always be interpreted in the context of the equipment history and your experience.

PI TEST RESULT	INSULATION CONDITION
<1,0	Unsatisfactory
1,0 to 2,0	Dubious
2,0 to 4,0	Good
>4,0	Very Good

There are two specific conditions to be aware of when interpreting **PI** test results, particularly if a history of the equipment is unavailable.

1) Dry, brittle insulation (e.g. on windings) on can give a high **PI** but fail under shock conditions.

2) If multi-layered insulation fails in one of the layers while the others retain high resistances, the effect on the test current will tend to increase the **PI** value, masking possible problems from surface leakage caused by dirt and contamination.

Dielectric Absorption Ratio is the term applied to a **Polarization Index** at other time intervals using '**Setup**'. Whatever times are set, these will be carried through to the **Dielectric Discharge** (**DD**) test which produces a **P**I value while it is doing the **DD** test.

Dielectric Discharge Testing

The Dielectric Discharge (**DD**) Test is a diagnostic insulation test that allows ageing and deterioration of insulation to be assessed. The result is dependent on the discharge characteristic, so the internal condition of the insulation is tested, largely independent of any surface contamination. The charge that is stored in the insulation material under test, is measured during the discharge phase.

The charge that is stored during the insulation test is automatically discharged at the end of the test when the discharge resistors are switched across the terminals. The rate of discharge depends only on the discharge resistors and the amount of stored charge from the insulation.

The capacitive current quickly decays from a high value with a relatively short time constant (a few seconds). The absorption (or re-absorption during a discharge) current starts from a lower level but has a much longer time constant (up to several minutes). This is caused by ions and dipoles re-aligning themselves within the insulation. When an electric field is applied some ions are able to move, and some dipoles align themselves within the field. These effects reverse themselves slowly when the test voltage is removed, caused by particles returning to their natural random state.The **DD** test measures the discharge currents 1 minute after an insulation test has been completed. At this time the capacitive current has usually become insignificant compared with the re-absorption current. The level of re-absorption after this time shows the condition of the insulation material, providing that the insulation material has been fully charged for full absorption to take place (typically 10 to 30 minutes). A high re-absorption current shows that the insulation has been contaminated, usually by moisture. A low current usually shows that the insulation is clean and has not absorbed much moisture.

The dielectric discharge test measures the discharge current 60 seconds after the insulation test is completed. This is converted to a figure of merit which gives a figure for the quality of the insulation, independent of the test voltage. This value is temperature dependent so it is important to test at a reference temperature, or record the value.

The **DD** value is defined as:

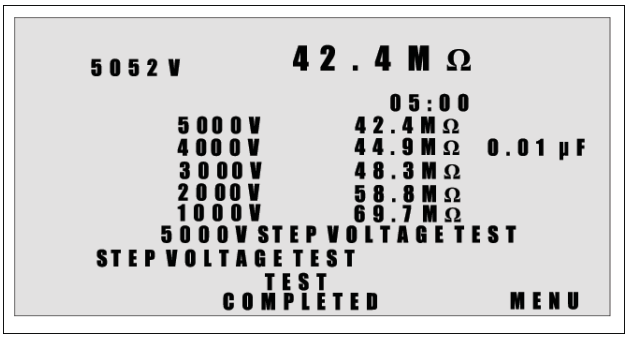
$$\frac{\text{Current flowing after 1 minute (mA)}}{\text{Test Voltage (V) x Capacitance (µF)}} = \frac{I_{1min}}{V \times C}$$

The maximum **DD** value that can be measured (assuming the default test voltage of 500 V) is typically 20, if the capacitance of the test sample is 1µF, but decreasing to 2 for a capacitance of 10 µF. If the maximum value has been exceeded the result will show a '**>**' symbol in front of the number (e.g. '**>20**').

DD Test Result (in mA $V^{-1}F^{-1}$)	Insulation Condition
>7	Bad
>4	Poor
2 - 4	Questionable
<2	O.K.

Step Voltage Testing

This test is based on the principle that an ideal insulator will produce identical insulation readings at all voltages, while an insulator which is being over stressed, will show lower insulation values at higher voltages. The selected voltage (2,5 kV or 5 kV) steps from zero by one fifth of the final value every minute, for 5 minutes, taking successive measurements until the final voltage value is reached.



Example of Step Voltage Testing display

Fault Conditioning (Burn)

For a normal Insulation resistance test, when a Burn test is not initiated, the voltage will be turned Off after a breakdown. This reduces the possibility of unintentional damage to the insulation by carbon tracking, or by arcing. Burn test mode disables the 'breakdown' detector and allows the Insulation resistance test voltage to be continued until it causes burning and insulation breakdown at a weak point of the circuit. If a Burn test is initiated, the instrument will maintain the high voltage even after a breakdown is caused, enabling the location of the failure to be seen or heard.

Data Retrieve

Results are automatically stored when a test runs for more than one minute. Tests are identified by date and test number. At each date change, test numbering restarts at **1**.The time of the test (24 hour clock format) is also stored. A maximum of 75 tests can be stored. Attempting to store more than 75 tests will cause the oldest test results to be erased. A warning message will appear before test results are automatically erased.

Display Stored Test results

1. From the '**Menu**' screen, use the left hand cursor st keys to select and highlight '**RETRIEVE**'.
2. Press the '**START**' ■ key. The output device list is displayed.
3. Use the left hand cursor st keys to select and highlight '**DISPLAY**'.
4. Press the '**OK**' ▣ key. The first test results are displayed.
5. Press '**NEXT**' ■ and '**LAST**' ■ keys to display subsequent or previous test results.
6. On completion press the '**END**' ▣ key to return back to the '**Menu**' screen.

Download stored Test results to a Printer

An external Printer can be connected to the optically isolated RS232 connector in the side recess panel. It is safe to connect a printer to this socket while tests are being performed. Test results can be sent in real time, and the data output rate can be adjusted from 1 to 60 seconds via the **Setup** screen. The default Baud rate is 9600, and this can be adjusted via the **Setup** screen. Test results are sent to the RS 232 socket every 5 seconds. The format of the output data is comma delimited **ASCII**.

1. Connect and set up the Printer.
2. From the '**Menu**' screen, use the left hand cursor keys to select and highlight '**RETRIEVE**'.
3. Press the '**START**'■ key. The '**SELECT OUTPUT DEVICE LIST**' screen is displayed.
4. Use the left hand cursor keys to select and highlight '**PRINTER**'.
5. Press the '**OK**' ▣ key. The first test results are displayed.
6. Press '**NEXT**' ■ and '**LAST**' ■ keys to display the required test results.
7. Press the '**START**' ▣ key. The message '**PRINTOUT IN PROGRESS**' is displayed.
8. When the completed message is displayed, press the '**MENU**' ▣ key to return back to the '**SELECT OUTPUT DEVICE LIST**' screen.
9. Press the '**END**' ▣ key to return back to the '**Menu**' screen.

Downloading Test results to a PC

Test results may be downloaded to a PC in one of two ways..... '**Real Time**' (downloading while carrying out a test) or '**Batch**' (downloading a single or multiple results after a test(s) has been completed and stored in the memory of the S1-5010). In both cases, the download of results takes place via the RS232 port of the S1-5010 to a **COM** port of the PC.

'**Real Time**' downloading uses the **AVOLOAD** DOS program on the diskette supplied with the instrument.

'**Batch**' downloading uses the **AVODNLDR** DOS program on the diskette supplied with the instrument.

Examples of a '**Real Time**' display, and '**Batch**' displays are given in '**Appendix 1**'.
Instructions on how to use both programs are contained in the **README** file on the diskette.
Alternatively, the S1-S1 '**Windows**' program can be used to set up and control the S1-5010 instrument, and download '**Real time**' and '**Batch**' data. See '**Accessories**'.

Preventive Maintenance

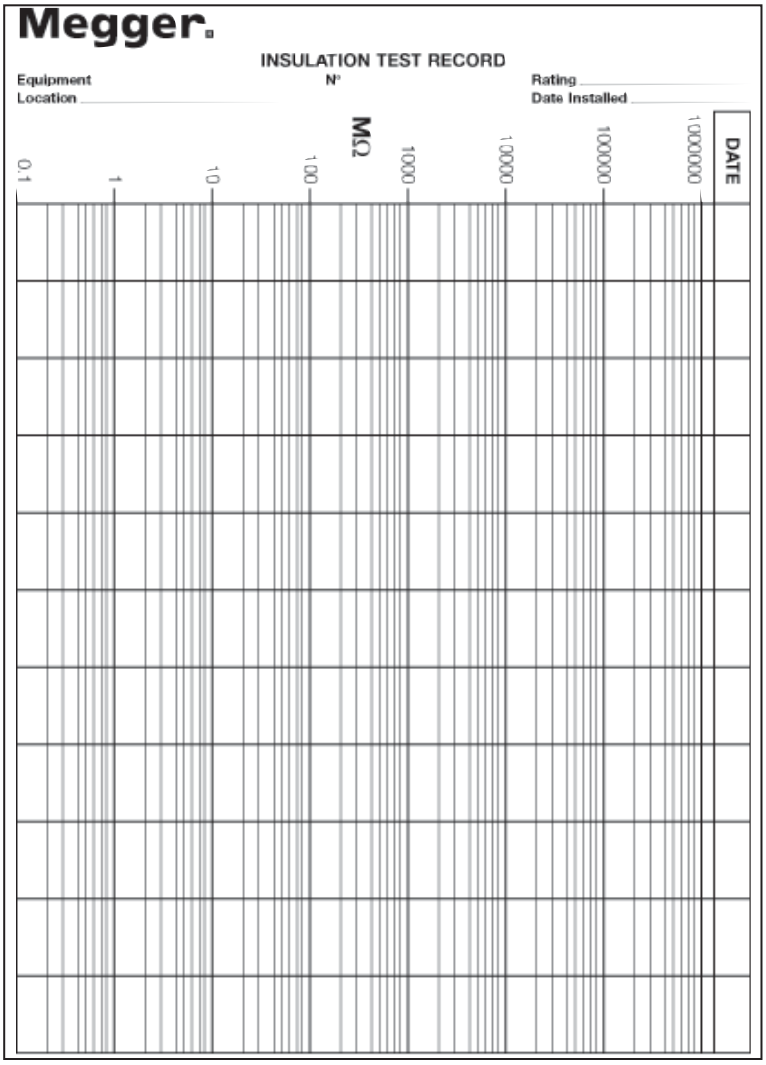
The proverb '**A stitch in time saves nine**' inspired the title of an Megger Limited booklet on insulation testing, as it neatly sums up the benefits of preventative maintenance. The savings come in financial terms from costly repairs, lost production, lost profits and in human terms, from lives saved in the event of dangerous electrical faults.

Regular insulation testing of electrical equipment can help to detect deteriorating insulation. The effects which cause insulation to deteriorate include mechanical damage, vibration, excessive heat or cold, dirt, oil, moisture and localized voltage stresses - all of which can arise on most industrial or utility equipment.

Insulation tests are sometimes used in isolation as absolute measures of the quality of the insulation. This is most appropriate when equipment is being installed and checked for compliance with a specified '**Pass**' level. For operational equipment the key factors are trends in the insulation readings.

It is therefore important that records of insulation readings are kept, relating to each piece of equipment or 'Asset' in your testing regime. Megger supplies test record cards to assist with such record keeping, and now with the S1-5010, the results can be downloaded directly to a computer.

There are also a number of influences on the insulation readings - temperature, humidity and surface leakage for example and a range of test techniques have been developed to help with the interpretation of your insulation tests.



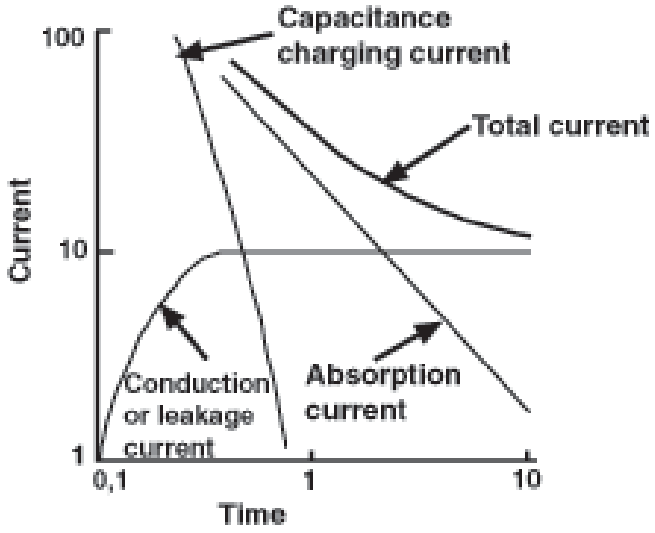
Example Test Record card

Insulation Testing Concepts

Insulation resistance can be considered by applying Ohm's Law. The measured resistance isdetermined from the applied voltage divided by the resultant current,

$$R = \frac{V}{I}$$

There are two further important factors to be considered. These are (i) the nature of the current through and/or over the insulation, and (ii) the length of time for which the test voltage is applied. These two factors are linked. The total current that flows is made up of three separate currents:



Components of insulation test current

1. Capacitance charging current. This current is initially high and drops as the insulation becomes charged up to the applied voltage.
2. Absorption current. This current is also initially high but drops at a much slower rate than the charging current.
3. Conduction or Leakage current.This is a small steady current that can be sub-divided into two:-
   (a) A current flowing along conduction paths through the insulation material.
   (b) A current flowing along conduction paths over the surface of the insulation material.

As the total current depends upon the time for which the voltage is applied, Ohm's Law theoretically applies at infinite time.

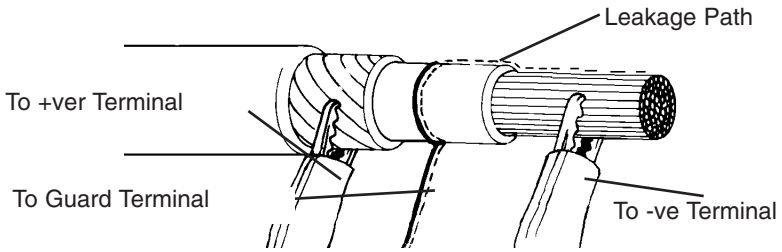
The charging current falls relatively rapidly as the equipment under test becomes charged up. The actual length of time depends upon the size and capacitance of the item under test.

Larger items with more capacitance will take longer e.g. long supply cables. The absorption current decreases relatively slowly compared with the charging current. In essence it depends upon the nature of the insulation material.

The conduction or Leakage current builds up quickly to a steady value and then remains constant for a particular applied voltage under stable conditions. It is this current that is affected by moisture, dirt etc. and the degree to which it flows bears a direct relation to the quality of the insulation, and consequently to the value of the insulation resistance measured. An increase in the leakage current is a pointer to possible future problems.

Using the Guard terminal

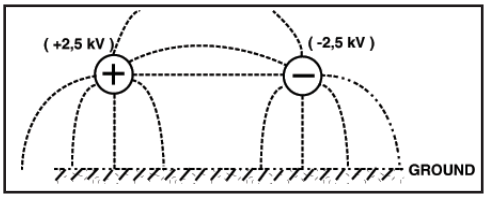
For basic insulation tests and where there is little possibility of surface leakage affecting the measurement, it is unnecessary to use the guard terminal. i.e. if the insulator is clean and there are unlikely to be any adverse current paths. However in cable testing, there may be surface leakage paths across the insulation between the bare cable and the external sheathing due to the presence of moisture or dirt. Where it is required to remove the effect of this leakage, particularly at high testing voltages, a bare wire may be bound tightly around the insulation and connected via the third test lead to the guard terminal '**G**'.



The guard terminal is at the same potential as the negative terminal. Since the leakage resistance iseffectively in parallel with the resistance to be measured, the use of the guard causes the current flowing through surface leakage to be diverted from the measuring circuit. The instrument therefore reads the leakage of the insulator, ignoring leakage across its surface.

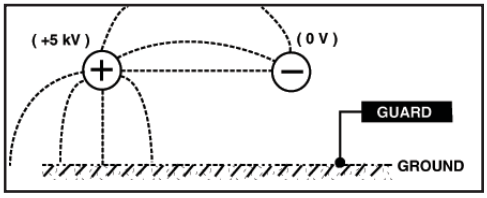
Measurements above 100 G

Measurements up to 100 GΩ can be made without any special precautions, assuming that the test leads are reasonably clean and dry. The guard lead can be used to remove the effects of surface leakage if necessary. The S1-5010 is capable of measuring up to 5 TΩ, and down to 0,01 nA (equivalent to 500 TΩ at 5000 V). When measuring resistances this high, the test leads should not be allowed to touch each other or any other object since this will introduce leakage paths. Sharp points at the test lead connections should also be avoided since this will encourage corona discharge.

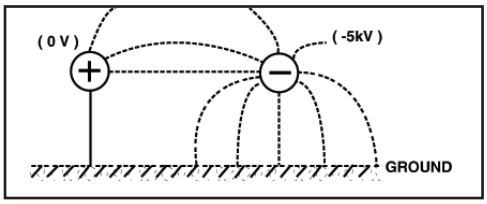


The drawing shows the stresses and subsequent leakages which will occur between the test leads if neither is connected to earth (ground). These leakages have significant effect and occur through the air itself.

The following drawing shows the effect of connecting the guard lead to the ground. This reduces the stray leakage into the negative (measurement input) terminal considerably, but this technique is only permissible if the item under test is isolated from the ground. ('Isolated' means insulated by a resistance of at least 5 MΩ for the positive terminal or 10 kΩ for the negative terminal).

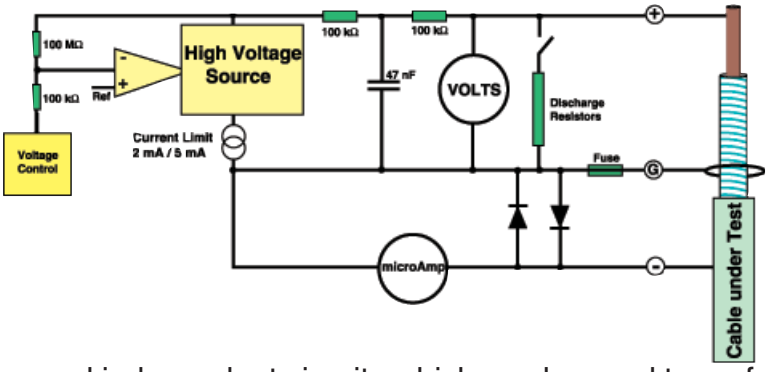


The following drawing shows a problem which can occur. If one end of the sample is grounded and this is required to be connected to the positive terminal, then the negative (measurement) lead is surrounded by a 5 kV field. This is likely to cause at least 1 nA of unwanted leakage current, representing a 5 TΩ resistance in parallel with the sample under test.



When taking measurements above 100 GΩ therefore, the user should ground the Guard Lead where possible, otherwise parallel leakage paths may occur.

Circuit Block Diagram



Calibration check

The S1-5010 contains several independent circuits which can be used to perform comparative checks without the use of any external equipment. If the automatic calibration check passes, this means that most of the instrument functions are working correctly. This section describes further simple checks which can be performed to test those areas not covered by the automatic calibration check.

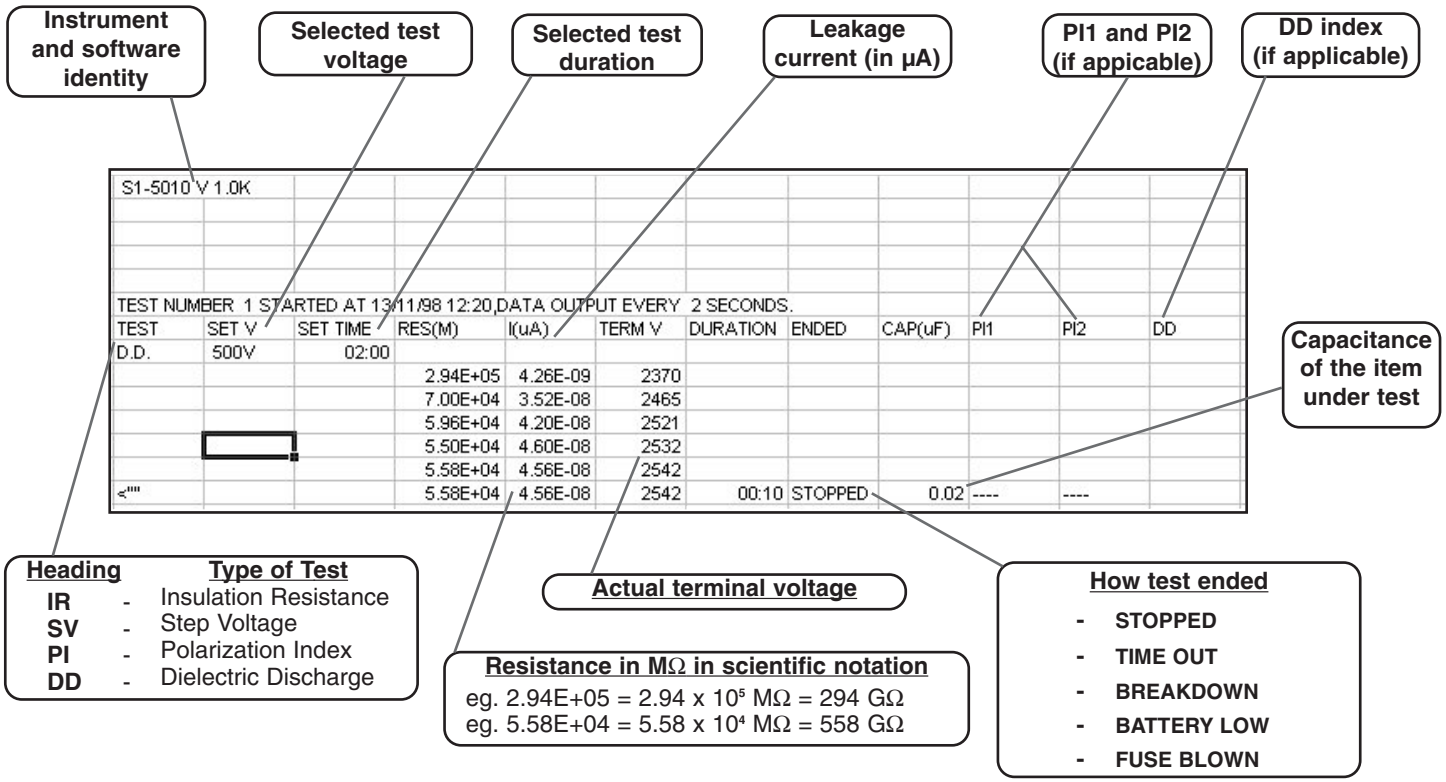
The S1-5010 has three measuring ranges which are selected automatically. The calibration check uses an internal 5 µA current source to check the operation of the high current and medium current ranges. The results are shown as two numbers in the display and if calibration is successful, these numbers (which will be approximately 1.00) will disappear immediately so that the instrument is ready for use.

Successful completion of the calibration check indicates that two of the measuring ranges are working correctly when measuring the equivalent of about 200 MΩ. If these two ranges are working, it is most probable that the other range is also working. To be sure that the third range is working, run an insulation test with the test leads disconnected. There is an accurate internal leakage current of 5 nA which is always added to the current entering the negative terminal. This current is subtracted later, during the calculations. With the terminals open circuit, the instrument is effectively measuring 5 nA and if it measures this correctly will get a result of 0 nA ±0.2 nA. Visually checking this reading confirms that the third range is working correctly.

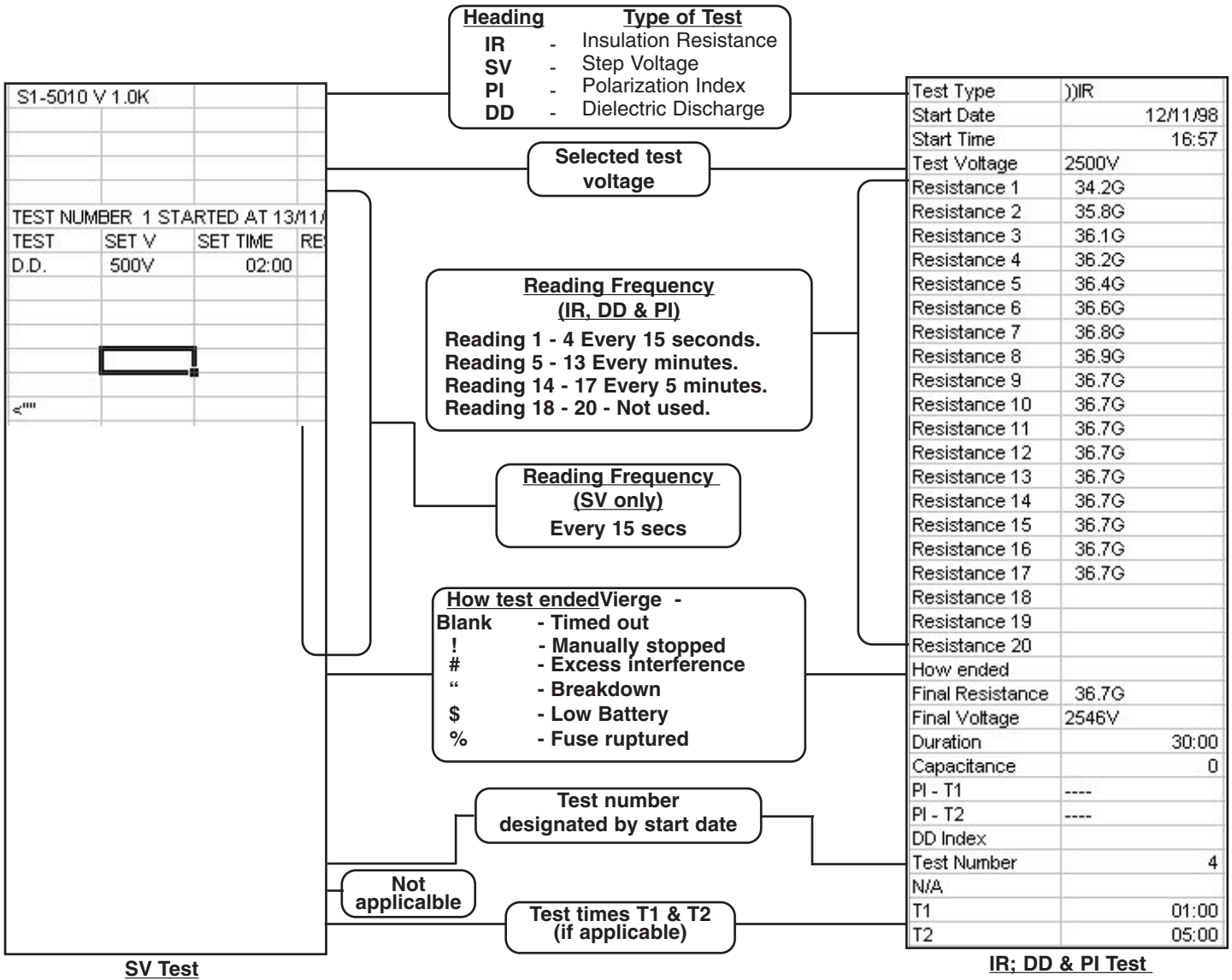
To achieve reliable resistance readings it is also necessary for the terminal voltage to be measured correctly. To quickly check the internal voltmeter, run an insulation test with the terminals open circuit at various voltages (e.g. 500 V, 1000 V, 2500 V and 5000 V). The voltage generated is specified to be accurate to ±5% but in practice it is usually better than this and about 1% higher than the nominal voltage.) Since the voltmeter circuit is independent to the voltage generator, visually checking the actual voltage reading gives a good degree of confidence that the internal voltmeter is working correctly. If all these tests are successful the confidence level for correct operation of insulation tests will be about 99%. The internal reference voltage has not been tested. (If this is wrong, everything would in error by the same amount and you would never know). To check the internal reference, connect an external voltmeter and start a test at a voltage which is within the capabilities of your voltmeter. (Please note that most voltmeters do not like more than 1 kV).

If you wish to perform a proper calibration check using external resistors, the CB101 5 kV resistor box with 10 MΩ, 100 MΩ, 1 GΩ and 10 GΩ resistors is available from Megger Limited.

Appendix 1


Instrument and software identity
Selected test voltage
Selected test duration
Leakage current (in µA)
PI1 and PI2 (if appicable)
DD index (if applicable)
S1-5010 V 1.0K
TEST NUMBER 1 STARTED AT 13/11/98 12:20,DATA OUTPUT EVERY 2 SECONDS.
TEST SET V SET TIME RES(M) I(uA) TERM V DURATION ENDED CAP(uF) PI1 PI2 DD
D.D. 500V 02:00
2.94E+05 4.26E-09 2370
7.00E+04 3.52E-08 2465
5.96E+04 4.20E-08 2521
5.50E+04 4.60E-08 2532
5.58E+04 4.56E-08 2542
5.58E+04 4.56E-08 2542 00:10 STOPPED 0.02 ---- ----
Capacitance of the item under test
Heading Type of Test
IR - Insulation Resistance
SV - Step Voltage
PI - Polarization Index
DD - Dielectric Discharge
Actual terminal voltage
How test ended
- STOPPED
- TIME OUT
- BREAKDOWN
- BATTERY LOW
- FUSE BLOWN
Resistance in MΩ in scientific notation
eg. 2.94E+05 = 2.94 x 10⁵ MΩ = 294 GΩ
eg. 5.58E+04 = 5.58 x 10⁴ MΩ = 558 GΩ

'Real Time' Download Display example



SV Test

IR; DD & PI Test

'Batch' Download Display examples

Specification

Test Voltages:		500 V, 1000 V, 2500 V, 5000 V 25 V to 5000 V in 25 V steps
Test Voltage accuracy:		±5% on 10 MΩ load and above ±25 V at test voltage <500 V ±12 V at test voltage <125 V
Test current limit:		2 mA or 5 mA (Selectable) Charge time:<2,5 s per µF to charge to 5 kV at 5 mA
Measurement ranges:		
Digital:	Resistance	10 kΩ to 500 GΩ at 500 V 10 kΩ to 1 TΩ at 1000 V 10 kΩ to 2,5 TΩ at 2500 V 10 kΩ to 5 TΩ at 5000 V
	Voltage	50 to 1000 V a.c./d.c. (5000 V when testing)
	Current	0,01 nA to 999 µA
	Capacitance	0,01 µF - 10,0 µF (measures up to 20 µF if <2.5 kV)
Analogue:	Resistance	10 kΩ to 1 TΩ
Accuracy: (0-30°C):	Resistance	±5% 1 MΩ to 1TΩ at 5 kV. ±5% 1 MΩ to 100 GΩ at 500 V. ±5% 1 MΩ to 10 GΩ at 50 V. ±20% 100 kΩ to 1 MΩ and 1 TΩ to 5 TΩ at 5 kV. ±20% 100 kΩ to 1 MΩ and 100 GΩ to 500 GΩ at 500 V.
	d.c. Test Voltage	±2% ±1 V
	Current	±5% ±0,2 nA
	Capacitance	±5% ±0,01 µF
Interference rejection:		4 mA at 50/60 Hz for <5% additional error (for test volts ≥ 500 V)
Max capacitance discharge:		20,0 µF at 5 kV, or 80 µF at 2,5 kV
Discharge time:		<100 ms per µF from 5 kV to 50 V
Guard terminal:		Guards out parallel resistance down to 250 kΩ Maximum additional error 5% at 100 MΩ
Operational supply:		95 - 280 V a.c. / 12 - 15 V a.c. or d.c.
Test Duration:		15 seconds to 90 minutes
Battery:		Internal rechargeable 12 V, 7 Ah lead acid
Battery life:		At least 8 hours from a fully charged battery
Display:		Backlit dot matrix LCD (256 x 128 pixels)
Battery Indicator:		Bargraph style level indicator
Safety:		Conforms to IEC 61010-1 Voltmeter rated for use on 300 V phase to earth systems, Category III.
Environmental Protection:		IP54 with side recess panel closed
EMC:		In accordance with IEC61326-1
Operational uncertainties:		Refer to www.megger.com
Temperature coefficient:		Measured current (>100 nA) 0,2% /°C Measured voltage 0,1% /°C
Temperature range:		Operating -20°C to +50°C Storage -25°C to +65°C
Maximum altitude:		2000 m
Humidity range:		90% RH non condensing at 40°C
Weight:		9 kg
Dimensions:		327 mm x 316 mm x 196 mm (+ 60 mm pouch)
Cleaning:		Wipe disconnected instrument with a clean cloth dampened with soapy water or Isopropyl alcohol (IPA).

Accessories

Supplied with the instrument	**Part Number**
User Guide	6172-283
High Voltage test lead, 3m long (3 supplied)	8101-181
RS232 communication lead	25955-025
PC download software	6220-594
Test record cards (x 5)	6172-112
Accessory pouch	6420-116

Optional	
Fused Test Lead Set	6320-240
8m HV Test Lead set	8101-182
15m HV Test Lead set	8101-183
Shielded test lead set	6311-080
12 V d.c. automotive charging lead	6231-584
Remote control / Download '**Windows**' software - S1-S1	6220-644
5 kV Calibration Box - **CB101**	6311-077
Test Record Card (Pack of 20)	6111-217

Publications	
'A Stitch in Time'	AVTM21-P8B

Repair and Warranty

The instrument circuit contains static sensitive devices, and care must be taken in handling the printed circuit board. If the protection of an instrument has been impaired it should not be used, and be sent for repair by suitably trained and qualified personnel. The protection is likely to be impaired if, for example, the instrument shows visible damage, fails to perform the intended measurements, has been subjected to prolonged storage under unfavourable conditions, or has been exposed to severe transport stresses.

New Instruments are Guaranteed for 1 Year from the Date of Purchase by the User.

Note:- Any unauthorized prior repair or adjustment will automatically invalidate the Warranty.

Instrument Repair and Spare Parts
For service requirements for Megger® Instruments contact

Megger Limited	Meggeror	Megger SARL
Archcliffe Road	Valley Forge Corporate Center	Z.A. Du Buisson de la Couldre
Dover	PO Box 9007 93340,	23 rue Eugène Henaff
Kent, CT17 9EN.	PA 19484-9007	78190 TRAPPES
England	U.S.A.	France
Tel: +44 (0) 1304 502243	Tel: +1 (610) 676-8500	Tel: +33 (1) 30.16.08.90
Fax: +44 (0) 1304 207342	Fax: +1 (610) 676-8610	Fax: +33 (1) 34.61.23.77

or an approved repair company.

Approved Repair Companies

A number of independent instrument repair companies have been approved for repair work on most Megger instruments, using genuine Megger spare parts. Consult the Appointed Distributor / Agent regarding spare parts, repair facilities and advice on the best course of action to take.

Returning Instrument for Repair

If returning an instrument to the manufacturer for repair, it should be sent freight pre-paid to the appropriate address. A copy of the Invoice and of the packing note should be sent simultaneously by airmail to expedite clearance through Customs. A repair estimate showing freight return and other charges will be submitted to the sender, if required, before work on the instrument commences.

Notes

Notes

Megger

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This instrument is manufactured in the United Kingdom.
The company reserves the right to change the specification or design without prior notice.

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